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ページ: 9/
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④ 発明の名称 欠陥シートの検出方法

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特 許 書

1. 発明の名称 欠陥シートの検出方法

2. 特許請求の範囲

シートに光を照射または漏光させ、その強度変化や光電検知することにより、シート上或いは内部に存在する欠陥を検出する方法において、同一欠陥に対して反射型光検知法として得られる電流値レベル値と、透過型光検知法として得られる電圧値レベル値とを調整することにより、共に検出する欠陥を判別することを特徴とする欠陥シートの検出方法。

3. 発明の発明の概要

(産業上の利用分野)

本発明は、シートに存在する欠陥を検出する方法に関し、特に検出された欠陥から更に加害する欠陥を極めて簡単に且つ精密よく判別する方法に関するものである。

(従来技術)

従来、製紙工場、プラスチックフィルム工場などでは、抄紙機や所管加工機等で製造された

座席シートを、必要に応じてスリッパ一組置やカッター一組置などにより巻取装置又は昇降機のシートに仕上っている。

これらのシートに大きなクレーンや吊りなどの欠陥があると、例えば印刷工場で印刷する際に欠陥部でインク塗布を施したり、裏面を汚してしまったり、特にシートが欠陥の包裏に使用される場合などには、欠陥の検出による欠陥は不具合であるのみならず、厚く両面イメージを低下させてしまう。そのため、僅か一匹の欠陥の検出でもクレームの対象となるため、欠陥の検出を防止すると同時に、欠陥に起因した欠陥を有するシートの取除を強く要求されている。

従来から、シートの製造工程に透過型や反射型の欠陥検出装置を設けており、シートの欠陥部分にマーキングして後工程でそれを取り除く方法が採用されている。これらの欠陥検出装置は、いずれもシートに存在する欠陥に基く光量の減衰現象を利用する装置であり、欠陥の存在及びその大きさ等を判定し、欠陥の大きさが約5mmを越える

特願2006-519745

ページ: 10/
(10)

ような場合には欠陥としてシートにマーキングが施される。しかし、それ以下の欠陥は、特にマーキングをすることなく、そのまま廃品として使用される。

ところが、本発明に要する欠陥は前述の如くシートの使用目的によっては、種々の場合であっても欠陥と同様に除去する必要がある。しかし、従来の欠陥検査装置では主に基づく欠陥と他の欠陥を判別することができない。そのため、欠陥の検出レベルをあげ、欠陥として同様に扱えないような大きな欠陥も全て欠陥としてマークし、それらを除去することも考えられるが、僅か一匹の小さな欠陥の付着に伴う欠陥を除去するために極めて多数のシートを除去することは、経済的にも実際の生産現場に及ぼすものでもあり、除去作業の増大と相俟って必ずしも現実的ではない。適切な検査装置が早く開発されているのが望みである。

【目的】

本発明の目的は、検出されたシート欠陥から生

じる、虫に起因する欠陥はその反射電気信号レベル値が透過電気信号レベル値に比べて何等もしくは大きくなり、チリ等に起因する欠陥では反射電気信号レベル値が透過電気信号レベル値に比べて小さくなることから成った。従って、透過電気信号と反射電気信号を演算し、及び検出された場合には全てシートにマークし、チリ等の欠陥についてはその大きさに応じてシートにマークして、後工程で除去することにより、徹底的、徹底的に極めて公平の欠陥検査が可能となるものである。

上記の如き本発明の方法をより具体的に説明するために、図面に掲げざるに詳細に説明する。

図1図は、連続シート(1)の両面を同時に検査するべく本発明の方法を適用する場合を示す。

シート(1)は矢印方向に連続的に進行し、順に上側監視用の反射型欠陥検査装置(2)の投光器(3)及び受光器(4)、下側監視用の反射型欠陥検査装置(5)の投光器(6)及び受光器(7)、

特許第61-175552(2)

に起因する欠陥を極めて簡単に且つ精度よく判別できる欠陥検査方法を発明することである。

【構成】

本発明は、シートに虫を反射または透過させ、その光強度化を光電検出することにより、シート上あるいは内部に存在する欠陥を検出する方法において、同一欠陥に対して反射型と透過型として得られる電気信号レベル値と、透過型光強度化として得られる電気信号レベル値とを演算することにより、虫に起因する欠陥を判別することを特徴とする欠陥シートの検査方法である。

【作用】

本発明等は、欠陥検査装置で検出された欠陥から、虫に起因する欠陥を判別する方法について、虫咬痕を特徴とした時、同一欠陥に対して透射型と反射型とで得られた電気信号レベル値と、反射型と透射型とで得られた電気信号レベル値を演算することにより、虫に起因する欠陥を判別できることを見出した。

虫咬痕に起因する欠陥検査装置(8)の投光器(9)及び受光器(10)が記載されている。

投光器(3、6、9)としては、従来の使用されている固体型電燈、リボンフイルAMENT電燈、コイルフイルAMENT電燈、ハロゲン電燈、キセノン放電ランプ、クセラフ水銀ランプなどの可視光線、紫外電燈、グローバー、ネオンストロークアー、ユクロムヒーター、カトリックヒーター、白金ヒーター、高圧水銀灯などの紫外線光源、あるいはレーザー、ガラス、YAG、Nd:YAGなどをレーザー材料とする固体レーザー、ヘリウムネオン、アルゴン、トリプトン、炭酸ガス、ヘリウムカドミウムなどをレーザー材料とするガスレーザー、GaAs、ZnS、ZnO、GaP、InP、GaIn、InAs、PbTeなどをレーザー材料とする半導体レーザーなどのレーザー光源などが使用される。

なお、シート(1)の途中に互いに均等に照射できるように、光路は適宜なビッチで設けられるが、本発明例の如き連続型光路として説明せず、一回の光路からの光を狭いビームに絞って検査面に

特願2006-519745

ページ: 11/
(11)

光を受ける。ビームの光路中に図1に示すように、被照体100を入れた受光部をシート面上に配置させる。所望のライティングスポットタイプの照度分布を用いることもできる。

受光部(4、7、10)としては、フォトダイオード、フォトトランジスタ、光電管、電荷結合素子(CCD)、アパランカメラダイオード、CMOSダイオード、赤外ビュン、赤外線検出素子、ノボトビュン、光電素子、熱電対、ホトグラフ、フォトセル、パトリセル、サーミスタなどが用いられる。

各受光部(4、7、10)から一定レベルで反射された光は、進行している被照体シート(1)の表面で反射される。あるいは透過してそれぞれの受光部(4、7、10)に入射される。

受光部(4、7、10)は入射される光を電気信号に変換する機能を有するもので、受光部からは光量に応じて電気信号が制御部110に出力される。制御部110では、各受光部110でゲインを調整することにより電気信号を電圧値とするとともに電圧値

る。

かかる結果に基づき制御部110は、必要に応じてアラーム110を鳴らすと同時に欠陥箇所を記録させてマーキング装置110によりシート上にマーキングを行うとともに、表示部110に欠陥が検出された欠陥であるかの表示を行うものである。

図2図は、平利シート(1)の両面チェックに本装置の方法を適用する場合を示す。

装置は主に検出部110、検出部110、検出部110で構成されている。

検出部は、例えばグリッパージェーンを用いて平利シートを所定のペースで移動させる方法で上下に駆けめれたシート送りコンベアで平利シートを挟みながら進む方法などの検出手段も採用できるが、検査効率の向上を目的として、シート方式のフィーダーを採用することによって検出効率を向上させることができる。

本発明の主要部をなす検出部110では、メイングリッパージェーン110、第1検出部110、第2検出部110、第3検出部110、第4検出部110

レベルが一定に調整され、ソフト開閉(11)で固定位置の値による位置の値が同一位置となるように調整される。

シートに欠陥があれば、反射率、透過率、反射率などの変化により、受光部に入射される光量が変化するので、欠陥に対応して受光部(4、7、10)から信号が出力され、この信号は制御部(11)でゲインに応じて増幅される。制御部(11)からの出力は欠陥信号とノイズの両方信号であるので、左の検出部110により欠陥信号のみが取り出されて制御部(11)に入力される。

制御部110は、入力された欠陥信号の処理を行うために、同一欠陥に対して得られた複数の欠陥検出結果による欠陥電気信号レベル値と、複数の欠陥検出結果による欠陥電気信号レベル値を比較して、反射率欠陥電気信号レベル値が透過率欠陥電気信号レベル値と同等もしくは大きい場合には、この欠陥に値が含まれると判定し、また反射率欠陥電気信号レベル値が透過率欠陥電気信号レベル値より小さい場合には、他の欠陥であると判定す

(11)が各々の側面を挟みながら水平に配置されている。各検出部110には、図示されていないが送られてくる平利シートの光路部をくわえて加工に用いることができるように、印刷機の送紙などで使用されるグリッパークラッチが設置されている。

第1検出部110(11)の上方には、シート上面をチェックする反射率欠陥検出装置(1)が、第2検出部110(12)の下方には、シート下面をチェックする透過率欠陥検出装置(2)が設置され、第3検出部110(13)は送紙先で平利シートをチェックするべく、アクリル系樹脂製の透明または半透明の中空パイプを挟み込んでおり、内部に検出部(11)、上方に受光部(10)が配置されており透過率欠陥検出装置(2)として作用するように構成されている。

なお、各検出部110のシートが送られる際には、平利シートが検出部110の検出部から引き上がり、固定位置を保持させるのを防止するべく、押入部(11)が取り付けられている。また、各受光部からの電気信号を処理するための回路は、第1回と同

特願2006-519745

ページ: 13/
(13)

全面としたフライングスポットタイプのもを供
返し、受光部(1、7、13)はフォトダイオード
を用いた。実施例1と同様にして得られた結果を
表-2に示す。

表-2

欠陥箇所	製造ロット レベル(%)	良品ロット レベル(%)	両者の 欠陥率差	欠陥による 平均減損	製造ロットに よる減損
1	2.2	2.2	=	点	全バツ
2	2.4	4.2	<	点	全バツ
3	2.7	2.8	=	点	全バツ
4	2.7	1.4	>	他の欠陥	ナシ
5	2.6	1.0	>	他の欠陥	ナシ
6	2.8	1.7	>	他の欠陥	ナシ

(結果)

本発明の方法に係る欠陥検査装置を使用すれば、
次に説明する欠陥を極めて簡単に且つ精度よく判
別できる。従って、検査能力が非常に増加する上、
クレーム発生時に必要とした調査の簡便性がかれ
るとともに、作業量に於いては手間及び負荷

特開2011-175552 (B)

が大幅に軽減される。

4. 装置の習得を説明

第1図は、本発明に係る欠陥検査方法を説明
シートの両面のチェックに適用した場合の一例
を示す。第1図は、本発明に係る欠陥検査
方法を平判シートの両面のチェックに適用した
場合の一例を示す。

- (1) : 連続シート(平判シート)
(2) : 上面検査用反射型欠陥検査装置
(3) : (上面検査用反射型欠陥検査装置の)
受光部
(4) : (上面検査用反射型欠陥検査装置の)
受光部
(5) : 下面検査用反射型欠陥検査装置
(6) : (下面検査用反射型欠陥検査装置の)
受光部
(7) : (下面検査用反射型欠陥検査装置の)
受光部
(8) : 透過型欠陥検査装置
(9) : (透過型欠陥検査装置の)受光部

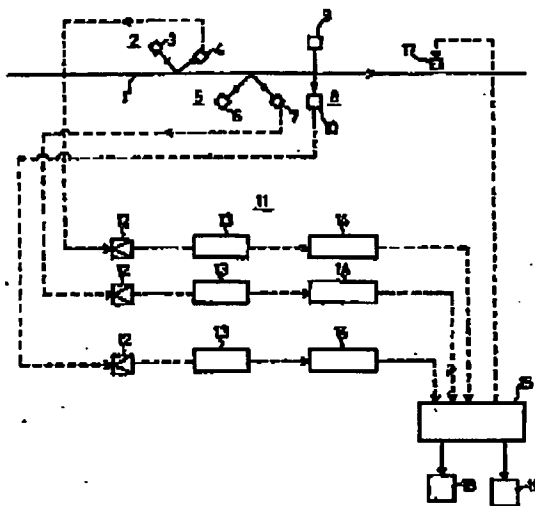
- (10) : (透過型欠陥検査装置の)受光部
(11) : 側面部 (12) : 端面部
(13) : レット部 (14) : 非レット部
(15) : 側面部 (16) : アラーム
(17) : マーキング装置 (18) : 表示部
(19) : 検査部 (20) : 検査部
(21) : 検査部
(22) : スインググリップ付きロール
(23) : 第1駆動部
(24) : 第2駆動部
(25) : 第3駆動部
(26) : 押入ロール (27) : シート山
(28) : 吸口 (29) : フィードロール
(30) : フェードボード
(31) : 加圧ベルト (32) : トランスファ
(33) : (デリバリーチェーン駆動部) チェー
ンホイール
(34) : デリバリーチェーン
(35) : 昇降用バレット
(36) : ロールバレット

特許出願人 特許取得株式会社

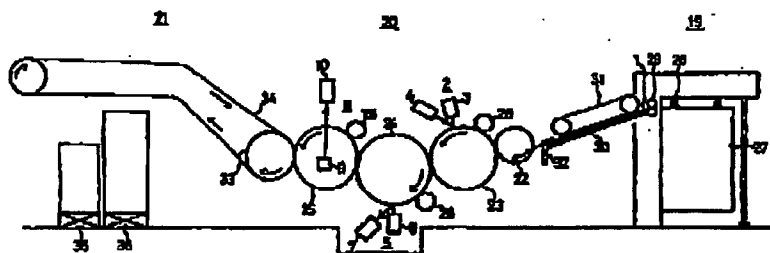
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REF ID: A61-175552 (8)

第 1 题



• **15** **2** **■**



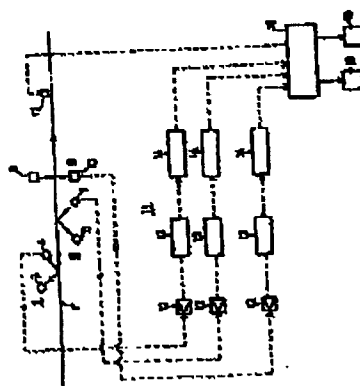
DETECTION OF DEFECTIVE SHEET

Publication number: JP61175552
 Publication date: 1986-08-07
 Inventor: KANEMOTO MASAMI; TOMITA KURA; TANAKA YOSHIKI; YUKI KAZUHIKO
 Applicant: KANZAKI PAPER MFG CO LTD
 Classification:
 - International: G01N21/89; G01N21/892; G01N21/88; (IPC1-7): G01N21/88
 - European: G01N21/89B
 Application number: JP19850017560 19850130
 Priority number(s): JP19850017560 19850130

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Abstract of JP61175552

PURPOSE: To discriminate a defect of sheet due to a bug easily and accurately, by computing an electrical signal level value due to changes in the quantity of light in terms of reflection and that due to the changes in the quantity of light of transmission type for the same defect. **CONSTITUTION:** An electrical signal is outputted to a circuit section 11 according to the quantity of light of light receiving units 4, 7 and 10 and the level thereof is adjusted to be constant by gain adjustment of an amplifier 12. Then, the difference in the phase due to the difference of measuring positions is adjusted with a shift circuit 13 to make the phase the same. With any defect on a sheet, the reflectance and transmissivity and the like changes and signals corresponding to the defect are inputted into the amplifier 12 from light receivers 4, 7 and 10, the output of which is a mixed signal wave of a defect signal and a noise. This defect signal alone is pick up with the subsequent discriminator and inputted into a control section 15 to compare the level values of defect electrical signals from upper/lower surface reflection type defect detectors 2 and 5 and the level value thereof from a transmission type defect detector 8. When the level values of the units 2 and 5 are equal to or larger than the level value of the unit 8, the defect due to a bug is discriminated.



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TRANSLATION of Japanese Patent Publication No. 61-175552
Title of the Invention: Method of detecting defective sheet
Publication Date: August 7, 1986
Utility Model Application: No. 60-17560
Filing Date: January 30, 1985
Applicant: Kanzaki Paper Co., Ltd.

SPECIFICATION

1. Title of the Invention: Method of detecting defective sheet

2. Scope of Claim for a Patent

A method of detecting a defective sheet by reflecting or transmitting the light on or through the sheet and detecting the change in light quantity thereof photoelectrically thereby to detect a defect existing on or inside the sheet, characterized in that the electric signal level value obtained as a reflection-type light quantity change and the electric signal level value obtained as a transmission-type light quantity change are calculated for the same defect thereby to identify a defect caused by an insect.

3. Detailed Description of the Invention
(Field of Industrial Application)

This invention relates to a method of detecting a defect of a sheet, or in particular, to a method of very simply and accurately identifying an insect-caused defect from all the defects that have been detected.

(Prior Art)

In the prior art, the continuous sheet fabricated by the paper machine or the drafting machine in the paper mill or the plastic film factory is finished into a roll or a

flat sheet by the slitter or the cutter as required.

In the presence of a large defect such as dust or oil stain on these sheets, the ink fails to attach at the defective point or the printing cylinder is fouled at the time of printing in the printing works. Especially in the case where the sheet is used for a food package, the defect caused by an insect mixing with or attaching to the sheet not only is insanitary but also greatly hurts the commodity image. Since even a single insect mixed in the commodity incurs a claim, the prevention of the intrusion of an insect and the removal of the sheet having an insect-caused defect are strongly required.

A conventional method has been employed in which a defect detection device of transmission type or reflection type is arranged in the sheet fabrication process to mark a defective part of the sheet, and the defective part thus marked is removed in the subsequent process. All of these defect detection devices are designed to determine the presence and size of a defect in the sheet taking advantage of the phenomenon of the light quantity change due to the defect. In the case where the defect size exceeds about 5 mm, the sheet is marked to have a major defect. A defect smaller than 5 mm, on the other hand, is regarded as a minor defect, and the sheet is used as a product as it is without any marking.

As described above, an insect-caused defect, even if minor, is required to be regarded as a major defect and removed in some specified applications. The conventional defect detection devices, however, cannot distinguish an insect-caused defect and other defects from each other. An idea for overcoming this disadvantage may be to raise the

defect detection level and to mark and remove, as major defects, all defects including those which are otherwise might be disregarded as minor defects. It is, however, against the common rule of effective use economic resources to remove a great amount of sheets simply due to a minor defect caused by a single insect. Also, this method is accompanied by an increased removal work and not necessarily satisfactory. Under the circumstances, a proper solution is in strong demand.

(Object)

The object of this invention is to provide a defect detection method whereby an insect-caused defect can be discriminated from other sheet defects very easily and accurately.

(Configuration)

According to this invention, there is provided a defective sheet detection method for detecting a defect existing on or inside a sheet by reflecting or transmitting the light on or through the sheet and detecting the light quantity change in a photoelectric way, characterized in that the electric signal level value obtained as a reflection-type light quantity change and the electric signal level value obtained as a transmission-type light quantity change are calculated for the same defect thereby to discriminate a defect caused by an insect.

(Operation)

The present inventors, as the result of making vigorous research efforts to distinguish an insect-caused defect from all the detected defects by daring to use both the transmission-type device and the reflection-type device for the same defect, have found that an insect-caused

defect can be discriminated by calculating, for the same defect, the electric signal level value obtained as a reflection-type light quantity change and the electric signal level value obtained as a transmission-type light quantity change.

Specifically, it has been found that an insect-caused defect has the electric signal level by reflection equal to or larger than the electric signal level by transmission while a defect caused by dust or the like has the electric signal level by reflection smaller than the electric signal level by transmission. By calculating the electric signal by transmission and the electric signal by reflection, all the sheets found to have an insect-caused defect are marked, while with regard to the sheets having dust-caused or other defects, on the other hand, only those having a defect larger than a predetermined reference size are marked, and these defects are removed in the subsequent process. In this way, the defects can be removed very efficiently in terms of both economy and operation.

The method according to the invention described above is explained in more detail specifically below with reference to the drawings.

Fig. 1 shows an application of this invention in which both surfaces of a continuous sheet (1) are checked at the same time.

The sheet (1) runs continuously in the direction of arrow to pass through a projector (3) and a photodetector (4) of a reflection-type defect detection device (2) for monitoring the upper surface, a projector (6) and a photodetector (7) of a reflection-type defect detection device (5) for monitoring the lower surface and a projector

(9) and a photodetector (10) of a transmission-type defect detection device (8) arranged in that order.

The projectors (3, 6, 9) used, as in the prior art, include a visible light source such as the heterothallic bulb, ribbon filament bulb, coil filament bulb, halogen lamp, xenon short-arc lamp or klepht mercury lamp, a infrared light source such as the incandescent lamp, glow bar, Nernst glower, nichrome heater, cartridge heater, platinum ribbon or high-pressure mercury lamp, or a laser light source such as a solid laser formed of the laser material such as ruby, glass, YAG or BEL, the gas laser formed of a laser material such as helium neon, argon, krypton, carbon dioxide gas or helium cadmium, or a semiconductor laser formed of a laser material such as GaAs, ZnS, ZnO, CdS, GaN, InP, GaSb, InAs or PbTe.

Incidentally, the light sources are arranged at appropriate pitches so as to radiate the sheet (1) uniformly over the entire width thereof. Without using a fixed light source as in this embodiment, however, what is called the flying spot-type projector may be used in which the light from one light source is reduced to a thin beam and the light spot thus produced on the surface of the sample is scanned on the sheet surface by a rotary mirror or a vibratory mirror inserted in the optical beam path.

The photodetectors (4, 7, 10) may be the photodiode, phototransistor, photoelectric tube, charge-coupled device (CCD), avalanche diode, pin diode, infrared vidicon, infrared detection element, noctovision, collector element, thermocouple, photon drug, Golay cell, patray cell (sic) or thermistor.

The light emitted at predetermined level from each

projector (3, 6, 9) is reflected from or transmitted through the surface of the running continuous sheet (1) and enters the corresponding photodetector (4, 7, 10).

The photodetector (4, 7, 10) has the function of converting the incident light into electricity, and an electrical signal corresponding to the light quantity is output from the photodetector to a circuit section (11). In the circuit section (11), the gain is adjusted first in an amplifier (12) thereby to amplify the electrical signal while at the same time adjusting each signal at a constant level, and the different phases caused by the difference in the measurement position are adjusted into the same phase by a shift circuit (13).

In the presence of a defect in the sheet, the light quantity incident to the photodetector is changed by the change in reflectivity, transmittance or reflection light axis. Thus, a signal corresponding to the defect is output from the photodetector (4, 7, 10) and amplified by the amplifier (12) in accordance with the gain involved. The output from the amplifier (12) is a mixed signal wave of the defect signal and the noise, and therefore, only the defect signal is retrieved by a discriminator (14) in the next section and input to a controller (15).

In the control unit (15), for the purpose of discriminating the input defect signal, the defect-related electrical signal level value from the reflection-type defect detection device and the defect-related electrical signal level value from the transmission-type defect detection device, which are obtained for the same defect, are compared with each other. In the case where the reflection-type defect-related electrical signal level

value is equal to or larger than the transmission-type defect-related electrical signal level value, the control unit (15) judges that the particular defect contains an insect, while in the case where the reflection-type defect-related electrical signal level value is smaller than the transmission-type defect-related electrical signal level value, on the other hand, the control unit (15) judges that the particular defect is other than caused by an insect.

Based on this result, the control unit (15) sounds an alarm (16) if required, while at the same time causing the marking unit (17) to attach a mark on the sheet in synchronism with the defective point and displaying on the display unit (18) whether the defect is caused by an insect or not.

Fig. 2 shows an application of the method according to the invention wherein the two surfaces of the flat sheet (1) are checked.

The device is configured mainly of a supply unit (19), a detection unit (20) and a discharge unit (21).

The supply unit can employ a well-known means such as a method of moving the flat sheet along a predetermined path using a gripper chain, for example, or a method of moving the flat sheet while being held by sheet feed conveyors arranged on both the upper and lower sides. Also, a high-speed operation is possible by employing a sheet-by-sheet feeder of the sheet-feed printing machine.

In the detection unit (20) making up an essential part of the invention, a roll with the swing gripper (22), a first-stage inspection roll (23), a second-stage inspection roll (24) and a third-stage inspection roll (25) are arranged almost horizontally with the side surfaces thereof

in contact with each other. Each inspection roll, though not shown, is installed with a gripper unit used for the pressure cylinder of the printing machine so that the forward end portion of the incoming flat sheet may be held and sent to the next process.

The reflection-type defect detection device (2) for checking the upper surface of the sheet is arranged above the first-stage inspection roll (23), and the reflection-type defect detection device (5) for checking the lower surface of the sheet under the second-stage inspection roll (24). The third-stage inspection roll (25), on the other hand, uses a transparent or translucent hollow pipe of acryl resin to check the flat sheet with the transmitted light. The third-stage inspection roll (25), with the projector (9) arranged therein and the photodetector (10) above it, is so configured as to operate as the transmission-type defect detection device (8).

Incidentally, on the side of each inspection roll contacted by the sheet, a pressure roller (26) is arranged to prevent the rise of the flat sheet from the surface of the inspection roll and the adverse effect on the measurement accuracy. Also, the circuit for processing the electrical signal from each photodetector is similar to the one shown in Fig. 1.

The operation method of the flat sheet defect detection device according to the invention is specifically explained below with reference to the configuration example described above.

The flat sheet (1) sent out one by one toward a feed board (30) through an intake port (28) and a feed roll (29) from a sheet stack (27) in the supply unit (19) is supplied

on the feed board in a manner to secure the regular feed under the pressure of an endless belt (31), until it stops with the front end portion thereof coming into contact with a transfer (32). Next, the front end portion is held by a roll (22) with a swing gripper rotated in the direction of arrow, and sent to the first-stage inspection roll (23) while being accelerated up to the rotational speed of the first-stage inspection roll (23). When passing through about one half of the upper surface of the first-stage inspection roll, the upper surface of the flat sheet is checked by the reflected light, followed by the lower surface thereof being checked similarly when passing through the second-stage inspection roll (24). After that, the sheet is checked by the transmitted light while passing through the third-stage inspection roll (25).

The front end portion of the flat sheet that has passed through all these check points is held by a holding hook of a delivery chain (34) when the third-stage inspection roll (25) and a chain wheel (33) for driving the delivery chain come closest to each other, and then transferred to the discharge section (21). The flat sheet that has arrived at the discharge section, if it has an insect-caused defect or other major defects detected by the detection unit (20), is automatically stacked on a recheck pallet (35), or otherwise, on an OK pallet (36).

Incidentally, the translucent sheet (1) usable in the method according to the invention may be formed of, for example, a fiber sheet having the opacity of 70 to 95 such as quality paper, art paper or coated paper, or a plastic sheet having the total light transmittance of not less than 40 % such as polyethylene, polypropylene, polystyrene,

polymethyl methacrylate, polyoxymethylene, polyvinyl chloride, polyvinylidene chloride, polyethylene terephthalate, polyamide, polyimide or a copolymer of any of these polymers and other polymers. Also, according to the embodiments described, the two surfaces of the sheet are checked. Nevertheless, the invention is of course applicable also to a case in which only one surface of the sheet is checked.

(Embodiments)

An embodiment of the invention is specifically explained below, and the invention is of course not limited to this embodiment.

[First embodiment]

While a roll of the 85-g/m² two-side art paper 92 in opacity with the 18-g/m² coating on one surface of the 50-g/m² base paper is wound back at the rate of about 600 m/min, the paper surface is checked by a defect detection device having the configuration shown in Fig. 1. The 110-W reflection lamp of Toshiba is used as a projector (3, 6, 9) constituting a visible light source, and the charge coupled device as a photodetector (4, 7, 10). The result of determining the detected defect according to the invention is compared with the result obtained by the actual visual inspection of the defective point as shown in Table 1. As apparent from Table 1, the result determined by the method according to the invention well coincides with the result of the visual inspection.

Table 1

A1	A2	A3	A4	A5	A6
1	2.2	3.6	<	A7	A8
2	4.5	4.9	<	A7	A8
3	4.1	4.8	<	A7	A9
4	0.5	1.4	<	A7	A10
5	1.8	1.0	>	A11	A12
6	3.4	2.1	>	A11	A12
7	4.1	2.3	>	A11	A13
8	4.9	2.6	>	A11	A14

(Footnote)

- A1 Defective point
- A2 Transmission signal level value (V)
- A3 Reflection signal level value (V)
- A4 Signal comparison
- A5 Result determined by the device
- A6 Result of visual inspection
- A7 Insect
- A8 Small fly
- A9 Fly
- A10 Thaumaleidae
- A11 Other defects
- A12 Dust
- A13 Scar
- A14 Wrinkle

[Second embodiment]

The flat sheet of polyethylene telephthalate 70 μ thick and 50 % in total light transmittance obtained by the biaxial stretcher with tenter is checked on two surfaces thereof, while being fed at the rate of 180 sheets per minute, on the defect detection device having the configuration shown in Fig. 2. The projector (3, 6, 9) of flying spot type is used with the helium neon laser as a

light source for emitting the visible light laser having the wavelength of 0.63 μm . The photodiode is used as the photodetector (4, 7, 10). As in the first embodiment, the result is obtained as shown in Table 2 below.

Table 2

A1	A2	A3	A4	A5	A6
1	3.2	3.6	=	A7	A8
2	3.4	4.2	<	A7	A10
3	3.7	3.8	=	A7	A8
4	2.7	1.4	>	A7	A12
5	2.6	1.0	>	A11	A12
6	3.2	1.7	>	A11	A14

(Footnote)

- A1 Defective point
- A2 Transmission signal level value (V)
- A3 Reflection signal level value (V)
- A4 Signal comparison
- A5 Result determined by the device
- A6 Result of visual inspection
- A7 Insect
- A8 Small fly
- A10 Thaumaleidae
- A11 Other defects
- A12 Dust
- A14 Wrinkle

[Effects]

The use of the defect detection device according to the method of the invention makes it possible to identify an insect-caused defect very simply and accurately. Thus, not only the processing capacity is increased but also the expense which otherwise might accrue upon occurrence of a claim is saved. At the same time, the labor and burden on

the part of the workers are greatly reduced.

4. Brief Description of the Drawings

Fig. 1 shows an embodiment in which the defect detection method according to the invention is used for checking the two surfaces of a continuous sheet. Fig. 2 shows an embodiment in which the defect detection method according to the invention is used for checking the two surfaces of a flat sheet.

- (1): Continuous sheet (flat sheet)
- (2): Reflection-type defect detection device for monitoring upper surface
- (3): Projector (for reflection-type defect detection device for monitoring upper surface)
- (4): Photodetector (for reflection-type defect detection device for monitoring upper surface)
- (5): Reflection-type defect detection device for monitoring lower surface
- (6): Projector (for reflection-type defect detection device for monitoring lower surface)
- (7): Photodetector (for reflection-type defect detection device for monitoring lower surface)
- (8): Transmission-type defect detection device
- (9): Projector (for transmission-type defect detection device)
- (10): Photodetector (for transmission-type defect detection device)
- (11): Circuit unit, (12): Amplifier
- (13): Shift circuit, (14): Discriminator
- (15): Control unit, (16): Alarm
- (17): Marking unit, (18): Display unit
- (19): Supply unit, (20): Detection unit

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- (21): Discharge unit
- (22): Roll with swing gripper
- (23): First-stage inspection roll
- (24): Second-stage inspection roll
- (25): Third-stage inspection roll
- (26): Pressure roll, (27): Sheet stack
- (28): Intake port, (29): Feed roll
- (30): Feed board
- (31): Endless belt, (32): Transfer
- (33): Chain wheel (for driving delivery chain)
- (34): Delivery chain
- (35): Recheck pallet
- (36): OK pallet